

Quarterly Progress and Performance Indicators Report:

Project Number and Title: 3.10 Assessment and Optimization of Double CT Bridge Girder Sections with Longitudinal Decks

Research Area: Thrust Area 3

PI: W. Davids, UMaine

Co-PI(s): H. Dagher, Maine

Reporting Period: 7/1/2021 - 9/30/2021

Submission Date: 9/30/2021

*****IMPORTANT: Please fill out each section fully and reply with N/A for questions/sections with nothing to report. For ease of reporting to the USDOT, please do not remove, or change the order of, any sections/text. You may remove/add each rows in tables as needed. Thank you! *****
The report is due on the last day of the reporting period in .doc format to tidc@maine.edu.

Overview:

Provide **BRIEF** highlights of activities performed during the reporting period. This summary should be written in lay terms for a general audience to understand. This should not be an extensive write up of findings (those are to be included in the final report), but a high-level overview of the activities conducted during the last three months **no more than 3 bullet points at no more than 1 sentence each**

- Creep monitoring has continued and analysis of to-date creep data has progressed
- The CT girder module (FRP girder with 4” precast concrete deck) underwent service load testing to produce moments due to construction loads.
- The CT girder specimen was completed by casting the additional 8” concrete on top of the 4” precast deck. This work included the addition of strain gauges to the steel reinforcement of the 8” concrete pour.
- The CT girder in its final configuration (FRP girder with a total of 12” concrete deck) was tested in four-point bending to produce moments per the AASHTO specifications. The specimen was then loaded to failure. The girder exhibited an unexpected failure of the top of the web at the web-flange interface at a lower-than-expected load.

Meeting the Overarching Goals of the Project:

How did the previous items help you achieve the project goals and objects? Please give one bullet point for each bullet point listed above.

- Data has been collected consistently, allowing information on the CT girder creep behavior to be collected and preliminary conclusions to be drawn
- The data collected during the testing allows for characterizing the stiffness of the CT girder module as it would be delivered to a project site.
- Continuous data recording during the pour of the 8” concrete deck and for the following week provides insight to the specimen’s behavior under distributed load. Additionally, the deflections and locked-in strains were monitored to address any questions regarding the short term behavior while the concrete cures.
- Loading the specimen to the different design loads helps in validating and improving the design process of the system. The premature and unexpected failure mode highlighted a critical design detail that must be explored further through additional testing and analysis.

Accomplishments:

List any accomplishments achieved under the project goals in bullet point form...

- Conclusions on girder creep behavior have been drawn and final reporting is progressing
- Instrumentation was checked before each phase of testing to ensure the quality of collected data

- Standard concrete cylinders cast during the 8” deck pour ensured the quality of the delivered concrete and that specimen testing was carried out after the concrete reached its design strength.
- Several samples were cut from the specimen post-testing to provide further information on the failure type and mode. The different events leading up to failure of the specimen are being highlighted in the collected data and video recordings of the test, and will inform future design and testing programs.

Task Progress and Budget:

Complete the following tables to document the work toward each task and budget (add rows/remove rows as needed, make sure you complete the Overall Project progress row and include all tasks even if they have ended or have not been started)...

Table 1: Task Progress			
Task Number: Title	Start Date	End Date	% Complete
Task 1: Specimen Design and Fabrication	7/1/2020	8/30/2020	100%
Task 2: Girder Shear Connector Testing	9/1/2020	12/30/2020	100%
Task 3: Girder Creep Testing	9/1/2020	11/31/2020	90%
Task 4: Girder Construction Performance Testing	9/1/2020	2/28/2021	70%
Task 5: Girder Strength Testing	3/1/2020	8/31/2021	40%
Overall Project:	3/1/2019	8/31/2021	60%

Table 2: Budget Progress		
Project Budget	Spend – Project to Date	% Project to Date (include the date)
\$240,376		

Is your Research Project Applied or Advanced?

- Applied** (The systematic study to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.)
- Advanced** (An intermediate research effort between basic research and applied research. This study bridges basic (study to understand fundamental aspects of phenomena without specific applications in mind) and applied research and includes transformative change rather than incremental advances. The investigation into the use of basic research results to an area of application without a specific problem to resolve.)

Professional Development/Training Opportunities:

Describe any opportunities for training/professional development that have been provided. Did you provide a training to a State DOT/AOT or industry organization? What was the training? When was it offered? How many people attended? Did you meet with a State DOT/AOT or industry organization to inform them of your findings and how these findings could help their organization? When? How many attended the meeting?

- During the reporting period, project personnel attended the 2021 TIDC Annual Conference. This gave an increased perspective on other TIDC projects and ways to incorporate other researchers’ experience into this and other projects.

Technology Transfer:

Complete all of the tables below and provide additional information where requested. Please provide ALL requested information as this is one of the most important sections for reporting to the USDOT. **ONLY provide information relevant to this reporting period.**

Use the table below to complete information about conference sessions, workshops, webinars, seminars, or other events you led/attended where you shared findings as a result of the work you conducted on this project:

Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events					
Type	Title	Citation	Event	Location	Date(s)
N/A					

Use the table below to report any publications, technical reports, peer-reviewed articles, newspaper articles referencing your work, graduate papers, dissertations, etc. written as a result of the work you conducted on this project. Please list only completed items and exclude work in progress.

Table 4: Publications and Submitted Papers and Reports				
Type	Title	Citation	Date	Status
N/A				

Answer the following questions (N/A if there is nothing to report):

- Did you deploy any technology during the reporting period through pilot or demonstration studies as a result of this work? If so, what was the technology? When was it deployed?
N/A
- Was any technology adopted by industry or transportation agencies as a result of this work? If so, what was the technology? When was it adopted? Who adopted the technology?
N/A
- Did findings from this research project result in changing industry or transportation agency practices, decision making, or policies? If so, what was the change? When was the change implemented? Who adopted the change?
N/A
- Were any licenses granted to industry as a result of findings from this work? If so, when? To whom was the license granted?
N/A

5. Were any patent applications submitted as a result of findings from this research? If so, please provide a copy of the patent application with your report.

N/A

6. Were any industrial contracts awarded base on furthering planned research and development activities as a result of findings from this work? If so, when? How much was awarded? Who awarded the contract?

N/A

Please add figures/images that can be included on the website and/or in marketing/social media materials to further clarify your research to the general public.

Insert figures here

Describe any additional activities involving the dissemination of research results not listed above under the following headings:

Outputs:

Definition: Any new or improved process, practice, technology, software, training aid, or other tangible product resulting from research and development activities. They are used to improve the efficiency, effectiveness, and safety of transportation systems. List any outputs accomplished during this reporting period:

- AIT bridges has received additional data and information regarding CT shear connector design which can be used to improve future bridge design
- AIT bridges is aware of girder failure mode and preliminary findings of the tests, which is informing the design of future bridges.

Outcomes:

Definition: The application of outputs; any changes made to the transportation system, or its regulatory, legislative, or policy framework resulting from research and development activities. List any outcomes accomplished during this reporting period:

- As a result of Task 2, AIT bridges has received additional data and information regarding CT shear connector design which can be used to improve future bridge design
- The detailed design around the area of failure is being refined based on the conclusions drawn from the testing.

Impacts:

Definition: The effects of the outcomes on the transportation system such as reduced fatalities, decreased capital or operating costs, community impacts, or environmental benefits. The reported impacts from UTCs are used for the assessment of each UTC and to make a case for Federal funding of research and education by demonstrating the impacts that UTC funding has had on technology and education. NOTE: The U.S. DOT uses this information to assess how the research and education programs (a) improve the operation and safety of the transportation system; (b) increase the body of knowledge and technologies; (c) enlarge the pool of people trained to develop knowledge and utilize technologies; and (d) improves the physical, institutional, and information resources that enable people to have access to training and new technologies. List any outcomes accomplished during this reporting period:

- As a result of Task 2, AIT bridges has received additional data and information regarding CT shear connector design. This has resulted in changes to current design projects.

Participants and Collaborators:

Use the table below to list **all** individuals (compensated or not) who have worked on the project.

Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members				
Individual Name & Title	Dates involved	Email Address	Department	Role in Research
William Davids	3/1/2019 - Current	william.davids@maine.edu	Civil and Environmental Engineering	Principal Investigator
Habib Dagher	3/1/2019 - Current	hd@maine.edu	Civil and Environmental Engineering	Co P.I.

Use the table below to list **all** students who have participated in the project during the reporting period. (This includes all paid, unpaid, intern, independent study, or any other student that participated in this project.) **ALL FIELDS ARE REQUIRED.**

Table 6: Student Participants during the reporting period								
Student Name	Start Date	End Date	Advisor	Email Address	Level	Major	Funding Source	Role in research
Andrew Schanck	2/1/2020	Current	William Davids		Ph.D	Civil Engineering	N/A	Testing, analysis of results, reporting

Use the table below to list any students who worked on this project and graduated or received a certificate during this reporting period. Include information about the student’s accepted employment (i.e. the student is now working at MaineDOT) or if they are continuing their students through an advanced degree (list the degree and where they are attending).

Table 7: Students who Graduated During the Reporting Period			
Student Name	Degree/Certificate Earned	Graduation/Certification Date	Did the student enter the transportation field or continue another degree at your university?
N/A			

Use the table below to list any students that participated in Industrial Internships:

Table 8: Industrial Internships
--

Student Name	Degree/Certificate Earned	Graduation/Certification Date	Did the student enter the transportation field or continue another degree at your university?
N/A			

Use the table below to list **organizations** that have been involved as partners on this project and their contribution to the project.

Table 9: Research Project Collaborators during the reporting period						
Organization	Location	Contribution to the Project				
		Financial Support	In-Kind Support	Facilities	Collaborative Research	Personnel Exchanges
Advanced Infrastructure Technologies	Brewer, Maine	X	X	X	X	x

Use the table below to list **individuals** that have been involved as partners on this project and their contribution to the project.

(List your **technical champion(s)** in this table. This also includes collaborations within the lead or partner universities who are not already listed as PIs; especially interdepartmental or interdisciplinary collaborations.)

Table 10: Other Collaborators				
Collaborator Name and Title	Contact Information	Organization and Department	Date(s) Involved	Contribution to Research
Ken Sweeney	ken@aitbridges.com	Advanced Infrastructure Technologies – AITBridges	3/1/2019 – Current	Technical Champion

Use the following table to list any transportation related course that were taught or led by researchers associated with this research project:

Table 11: Course List						
Course Code	Course Title	Level	University	Professor	Semester	# of Students
N/A						

Changes:

List any actual or anticipated problems or delays and actions or plans to resolve them (list no-cost extension requests here)...

The unanticipated girder failure mode indicates the need for additional girder testing under this project. This will require project extension and additional funding. We are currently exploring how this will be undertaken.

List any changes in approach and the reasons for the change...

Planned Activities:

List the activities planned during the next quarter.

- Analyzing and reporting all the girder test results collected to-date, reaching a consensus on all the conclusions that would affect future design of the CT girder system, and establishing funding and methods for additional testing.